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14. ABSTRACT
This was a request for acquisition of a high-end hybrid CPU-GPU computing facility, designed specifically to dramatically enhance current computing capabilities, and support algorithm development for computationally intensive stochastic and high-resolution simulations. The system will be used to support research in the areas of interest to a new MURI AFOSR.

See attached for further details.

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Final report on AFOSR FA9550-10-1-0333

DURIP10: Hybrid Computing Facilities Enabling Novel Developments for Stochastic Simulations and Research-related Education

Period of Award
July 1, 2009 – June 30, 2010

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Background

This was a request for acquisition of a high-end hybrid CPU-GPU computing facility, designed specifically to dramatically enhance current computing capabilities, and support algorithm development for computationally intensive stochastic and high-resolution simulations. The system will be used to support research in the areas of interest to a new MURI AFSOR.

The new facility is available to 9 PIs, 14 PhD and 6 post-doc students who work on the projects supported by DoD from Brown and also from other academic institutions, partners in the AFSOR MURI Project.

The computational platform comprises of integrated CPU and GPU systems; specifically, IBM Dual-processor/quad-core nodes with 48GB RAM each and 40Gb/s QDR Infiniband, and nVIDIA Tesla GPU system with a total of 88 GPUs. With the addition of the two requested 18-port switch leaf-modules, the 44 host computers will be connected to a Qlogic 12800 switch already installed at Brown. In addition, 66TB (usable) disk is requested, which will be integrated with the GPFS filesystem already installed at Brown. The request also included a number of small desktop systems to allow researchers to access the facility and effectively visualize the computational results. This latter component was not executed due to unexpected scheduling issues and the associated funds were returned to AFOSR.

Funding through DURIP has been instrumental for purchasing and establishing the proposed facility for which no other funds would have been available. Establishing the facility has helped to pave the way to greatly enhance the ability to locally develop and test novel parallel algorithms for solving large stochastic systems arising in the areas of DoD interest. It is widely acknowledged that such simulations tax the computational facilities much heavier than classical deterministic modeling approach. We also make use of the equipment for postprocessing, e.g., to visualize very large temporal datasets resulting from the simulation transient phenomena in general complex geometries. In addition, it will also significantly enhance educational and outreach programs.

The central components of the facility, i.e., the GPU/CPU hybrid cluster and the external storage systems are fully integrated with the networks and storage facilities of Brown's Center for Computation and Visualization (CCV) to further enhance the use of the facility and leverage the purchase against existing infrastruture and system support.

The central components of the facility are all highly flexible and expandable in capacity. Combined with the upgrade of the existing network hierarchy, central in order to achieve the expected performance locally as well as improve the connectivity to DOD HPC sites, the facility paved the way for an extensive, efficient, and reliable use of DOD HPC resources. The acquisition has established a powerful computational platform for novel algorithm development and research-related education in areas of research

relevant to the missions of DOD and will, due to the emphasis in the design of the facility on flexibility, expandability, and connectivity to existing resources, have an estimated useful life of 3-5 years.

The proposed system has been purchased, is fully functions and heavily utilized by faculty and students involved in AFOSR related research.

Equipment purchased

From IBM - 44 IBM iDataplex dx360 M3 nodes, each with:

- 2 Intel Xeon E5630 processors (4-core, 2.53GHz)
- 24GB DDR3 RAM
- 2 nVIDIA Tesla M2050 GPUs (Fermi architecture, 3GB GPU memory)
- Mellanox QDR (40Gb/s) Infiniband HCA

and including associated rack and Ethernet management switch hardware.

From IBM - 3 Qlogic Infiniband switch modules, installed in the extant Qlogic 12800-180 QDR Infiniband switch. These connections provide non-blocking access to ~300 terabytes of IBM GPFS parallel filesystem storage for data and run-time scratch storage.

From Server Supply – 33 2TB disk drives, 1 dual core Xeon server and 1 146GB SAS driver as disk server.